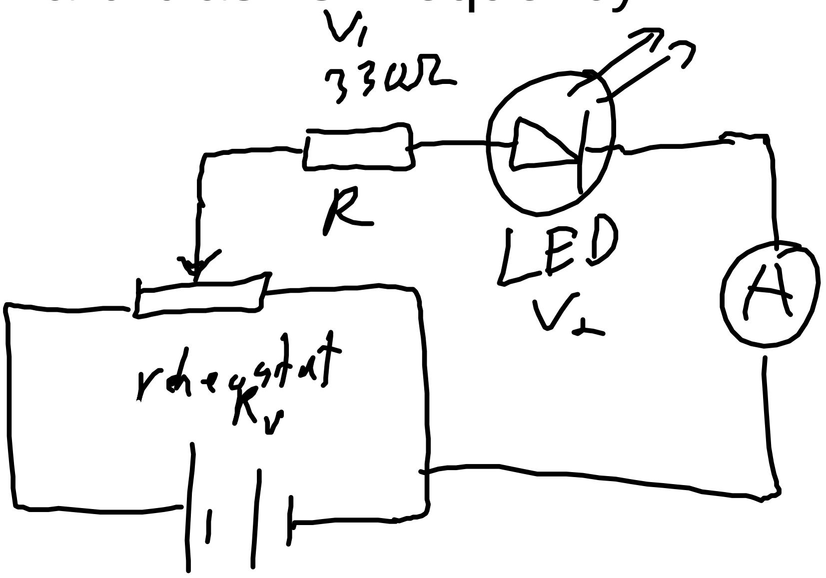
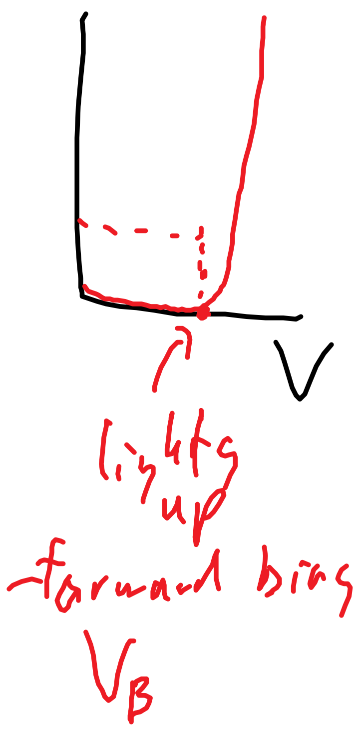
Diode forward bias vs Frequency



$V = 6.0V$

Resistor

Diode



e.g. red = 1.4V

$$V = \frac{\text{Energy}}{\text{charge}} \qquad \text{Energy} = Vq = hf$$

$$1.4V(1.6\times10^{-19}C) = 6.63\times10^{-34}\,Js\,f$$

$$f = 3.38\times10^{14}\,Hz$$

$$\lambda = \frac{c}{f} = \frac{3\times10^{8}}{3.38\times10^{14}} = 8.9\times10^{-7}\,\underline{m}$$

Greenhouse Gasses and Global Warming

Treat the sun as a blackbody radiator, the Earth as both a black body radiator and absorber, and greenhouse gasses as masses with "springs" that resonate at particular frequencies. Then we will add some factors to account for complexities.

Blackbody Radiation:

A perfect black body radiates energy at a rate proportional to the surface area and the Temperature in Kelvin to the forth power.

$$P = \sigma A T^4$$

not ideal "

$$P = \varepsilon \sigma A T^4$$

ε not ideal < 1

σ = Stefa-Boltzman's constant

$5.67 \times 10^{-8}\ W\ m^{-2}\ K^{-4}$

Peak of Blackbody emission

$$\lambda = \frac{2.90 \times 10^{-3}}{T}$$ Wien's Law

T in kelvin

Eg. 1. Determine the Power output of the Sun, the Earth and a person, and peak emission λ.

Sun - T=5780K, radius 6.96×10^8m.

Earth - 16ºC radius 6.38×10^6m

You - 37ºC area: 1.7 m^2

Assume blackbody.

1. If a human emits 75W, what is the emission constant e?
2. If the Earth is 1.50×10^{10}m away from the

Sun, what is the power input per unit area on the Earth, the intensity? What is the peak possible power output of a solar panel with area 2.0m^2?

3. Treat the earth as a sphere and calculate the equilibrium temperate where input (as a disc) and output(sphere) are balanced. (assume perfect blackbodies)

$$P = \sigma A T^4$$

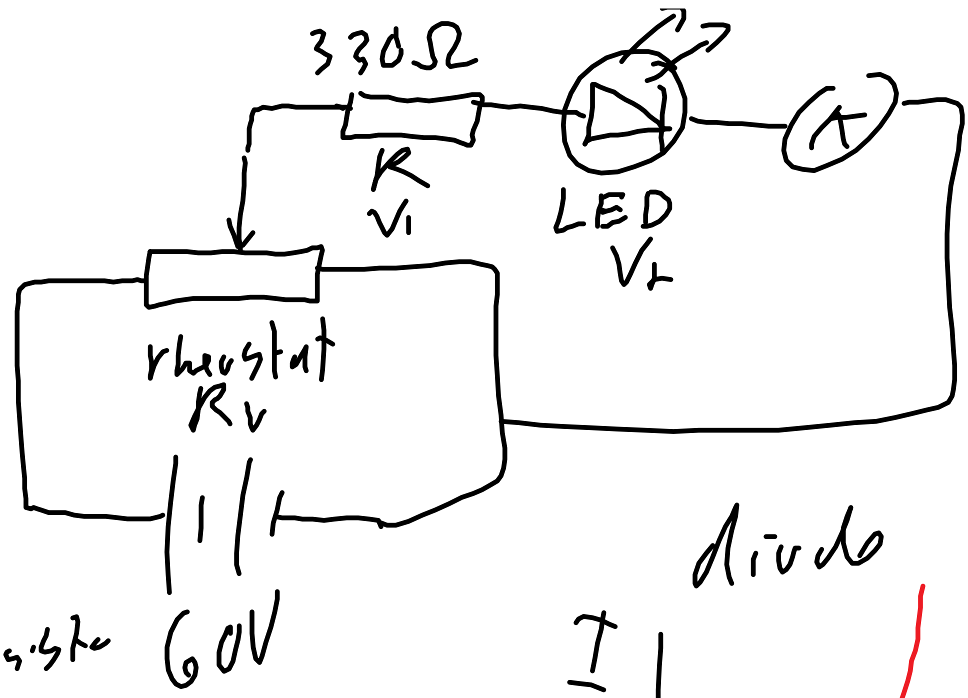
$$P = 5.67 \times 10^{-8} W (1.7 m^2)(37+273)^4$$

$$= 890 W$$

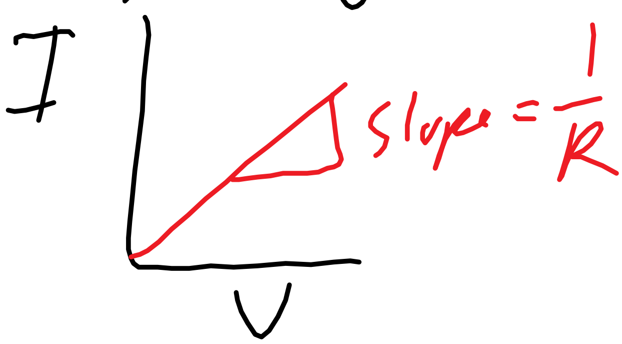
$$\varepsilon = \frac{75}{691} = \boxed{0.084}$$

Quantum Review, Blackbody and Greenhouse Gasses

Demo of different LEDs (light emitting diode)



Resistor



diode

$V_B = 1.4V$ red

$= 1.5V$ yellow

$= 1.6V$ green

$\Delta E_e = E_{photon}$

$V \times e = hf$

red $1.4 \cancel{V} \times 1.6\times10^{-19} C = 6.63\times10^{-34} Js\, f$

$f = 3.38\times10^{14}\ Hz$

$\lambda = \frac{c}{f} = \frac{3\times10^{8} m/s}{\ldots}$ $\boxed{\ldots\times10^{-7}}$

$$\lambda = \frac{c}{f} = \frac{3\times10^{8}\ \text{m/s}}{3.38\times10^{14}\ \text{Hz}} = \boxed{8.9\times10^{-7}\ \text{m}}$$

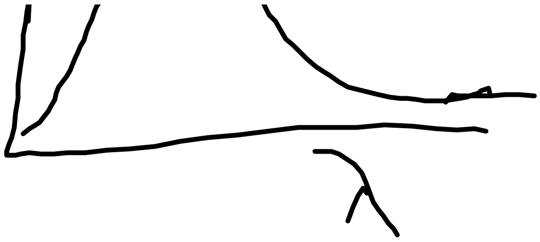
bit off

blackbody radiation

- classical theory:
charges vibrating should emit radiation

observed - like particle distribution

distri...



Energy is in bundles, $E = hf$

Depends on the temperature of the blackbody.

Surface area

$$P = e\sigma A T^4$$

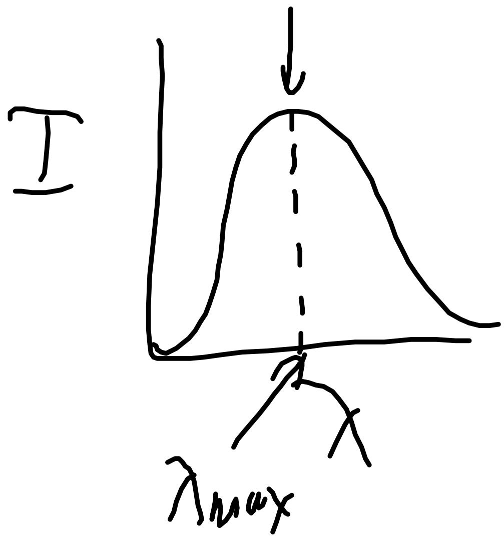
← temperature in Kelvin

Stefan-Boltzmann constant $5.67 \times 10^{-8}\ W m^{-2} K^{-4}$

emission constant

Power in watts

Peak wavelength ← emission intensity



$$\lambda = \frac{2.90 \times 10^{-3}}{T}$$

in Kelvin